Tricuspid Valvular Heart Disease

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Post graduate version 2019

For post-graduates

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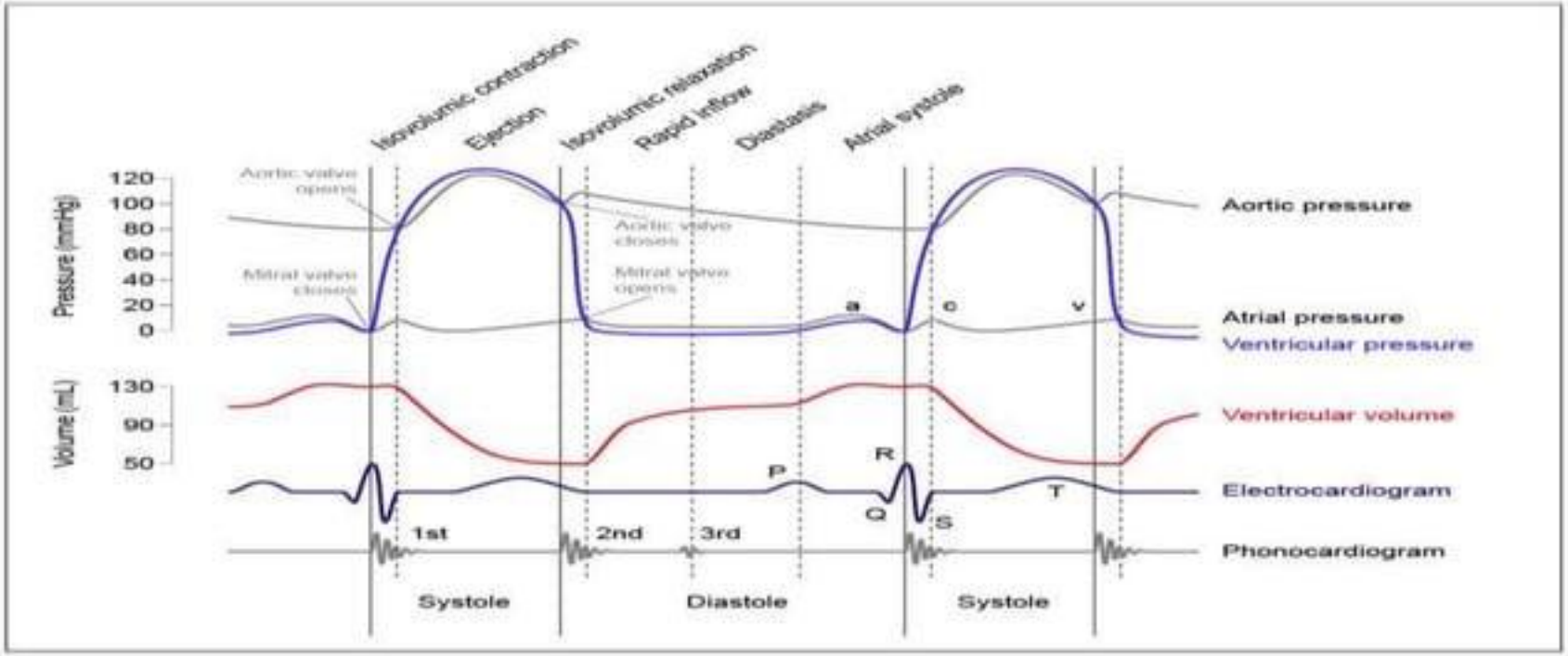
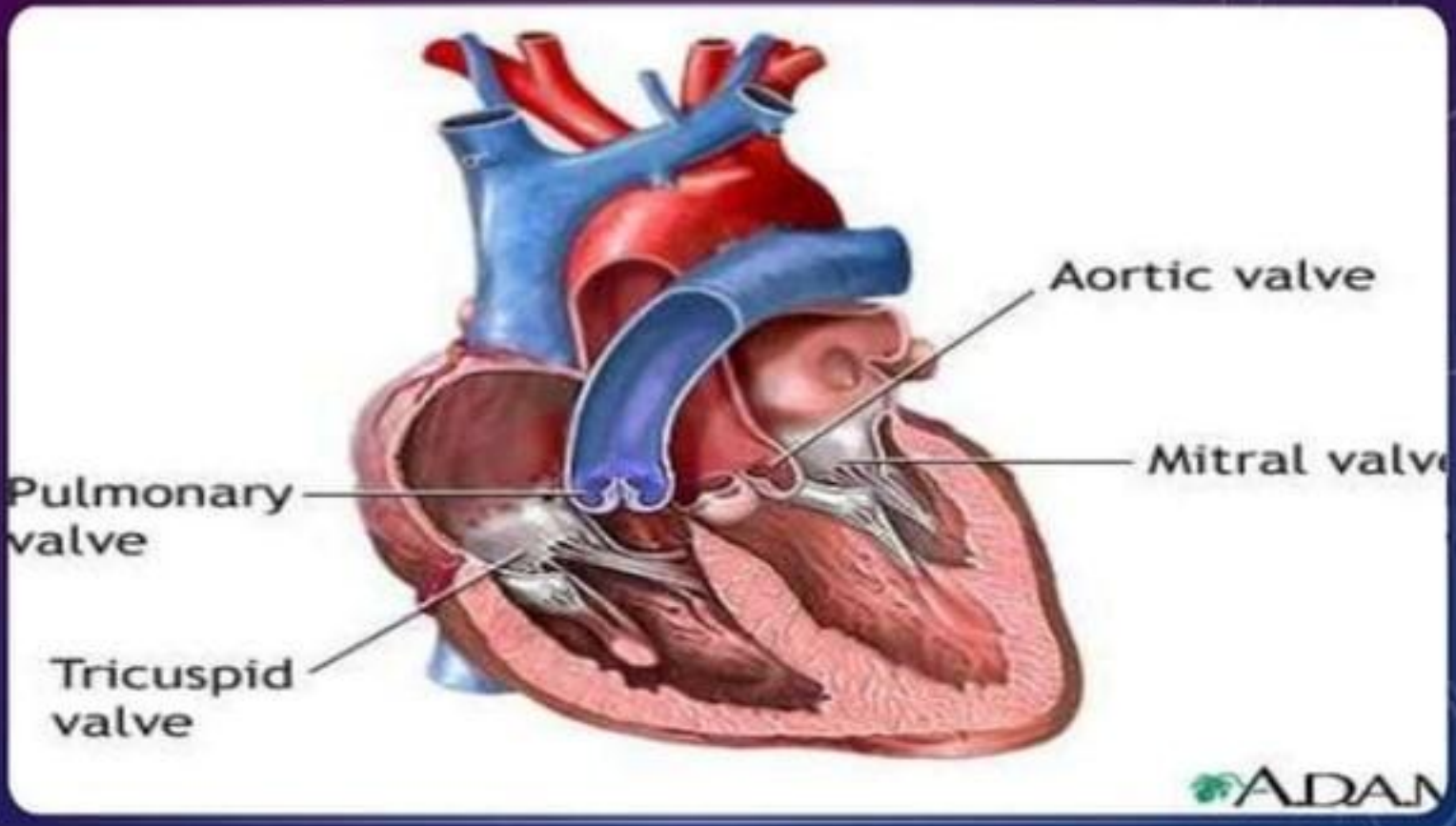
Normal valve function

- **Maintain forward flow and prevent reversal of flow.**
- **Valves open and close in response to pressure differences (gradients) between cardiac chambers.**

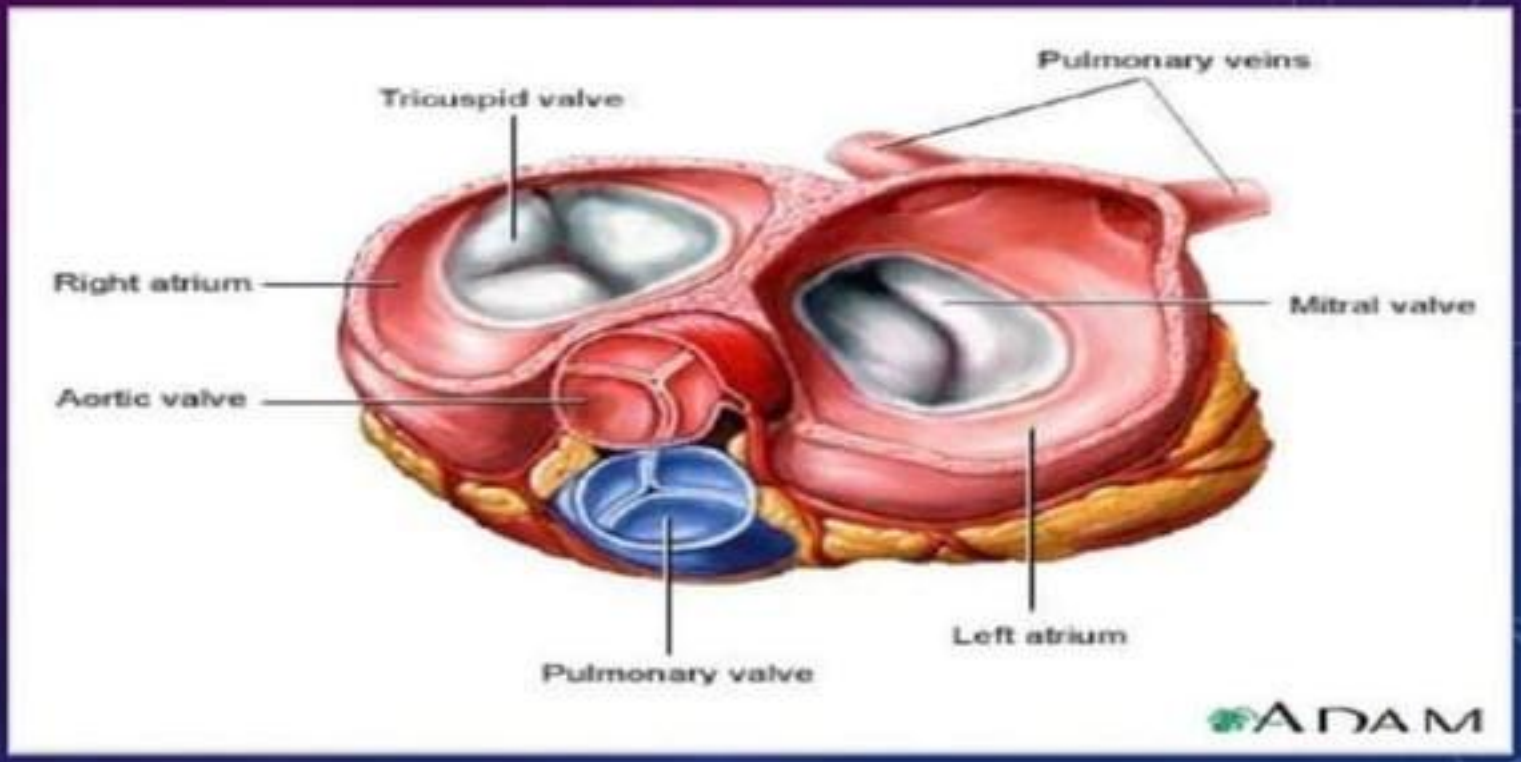


HEART VALVES

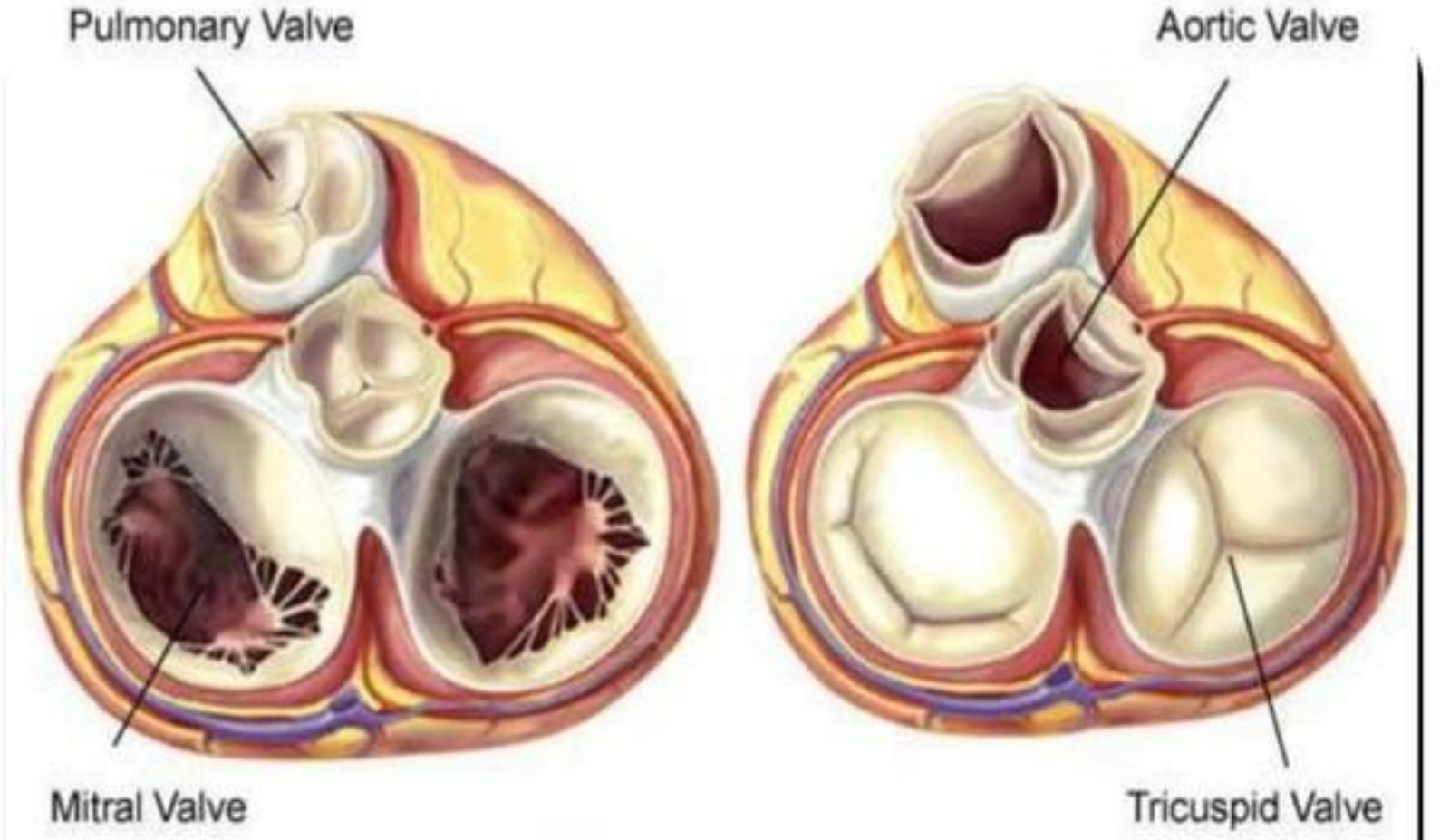


- Maintain 'one- way' blood flow through the heart.

HEART VALVES

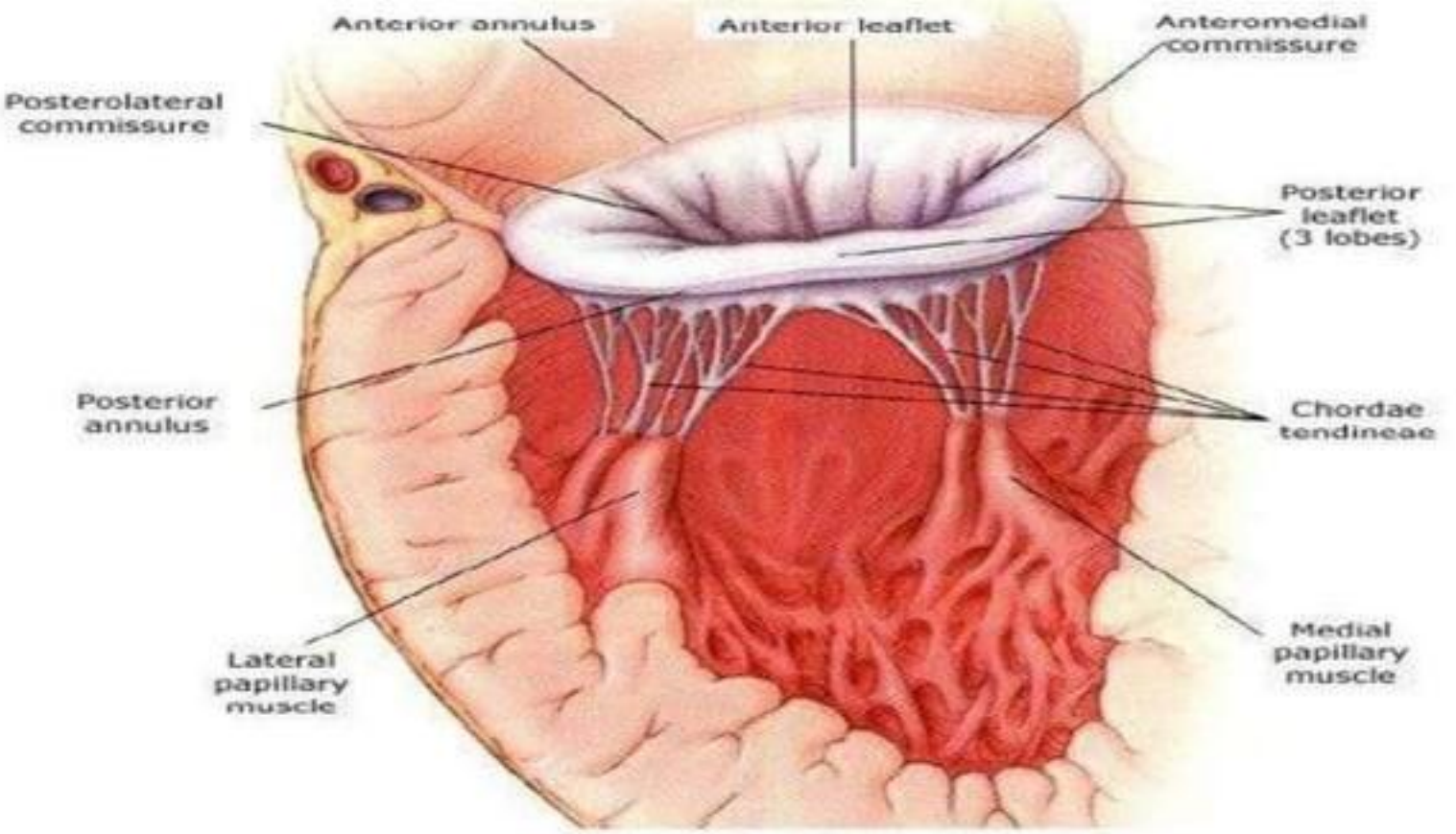


The four heart valves make sure that blood always flows freely in a forward direction and that there is no backward leakage.



Any disease of these valves is called valvular heart disease!

PARTS OF HEART VALVE



PARTS OF HEART VALVE

- **Annulus:** a (fibrous) ring like structure, or any body part that is shaped like a ring.
- **Commissure:** a site of union of corresponding parts; specifically, the sites of junction between adjacent cusps of the heart valves
- **Chordae tendineae**: thread-like bands of fibrous tissue that attach on one end to the edges of the tricuspid and mitral valves of the heart and on the other end to the papillary muscles.
- **Papillary muscles**: small muscle within the heart that anchors the heart valves.

Abnormal valve function

- Valve Stenosis
  - Obstruction to valve flow during that phase of the cardiac cycle when the valve is normally open.
  - Hemodynamic hallmark -"pressure gradient"
- Valve Regurgitation, insufficiency, incompetence
  - Inadequate valve closure → reverse flow of the blood, back leakage
- Combined – a single valve can be both stenotic and regurgitant; combinations of valve lesions can coexist
  - Single disease process
  - Different disease processes
  - One valve lesion may cause another
  - Certain combinations are particularly common(AS & MR, MS & TR)

CAUSES OF VALVULAR DISORDERS

- Congenital heart disease
- Rheumatic heart disease
- Infections – bacterial endocarditis
- Heart attack – damage to the heart muscle, papillary muscles
- Weakening of supporting structures of the heart

TYPES OF VALVULAR HEART DISEASE

Classified on the basis of :

1. Duration of dysfunction:

   Acute and chronic

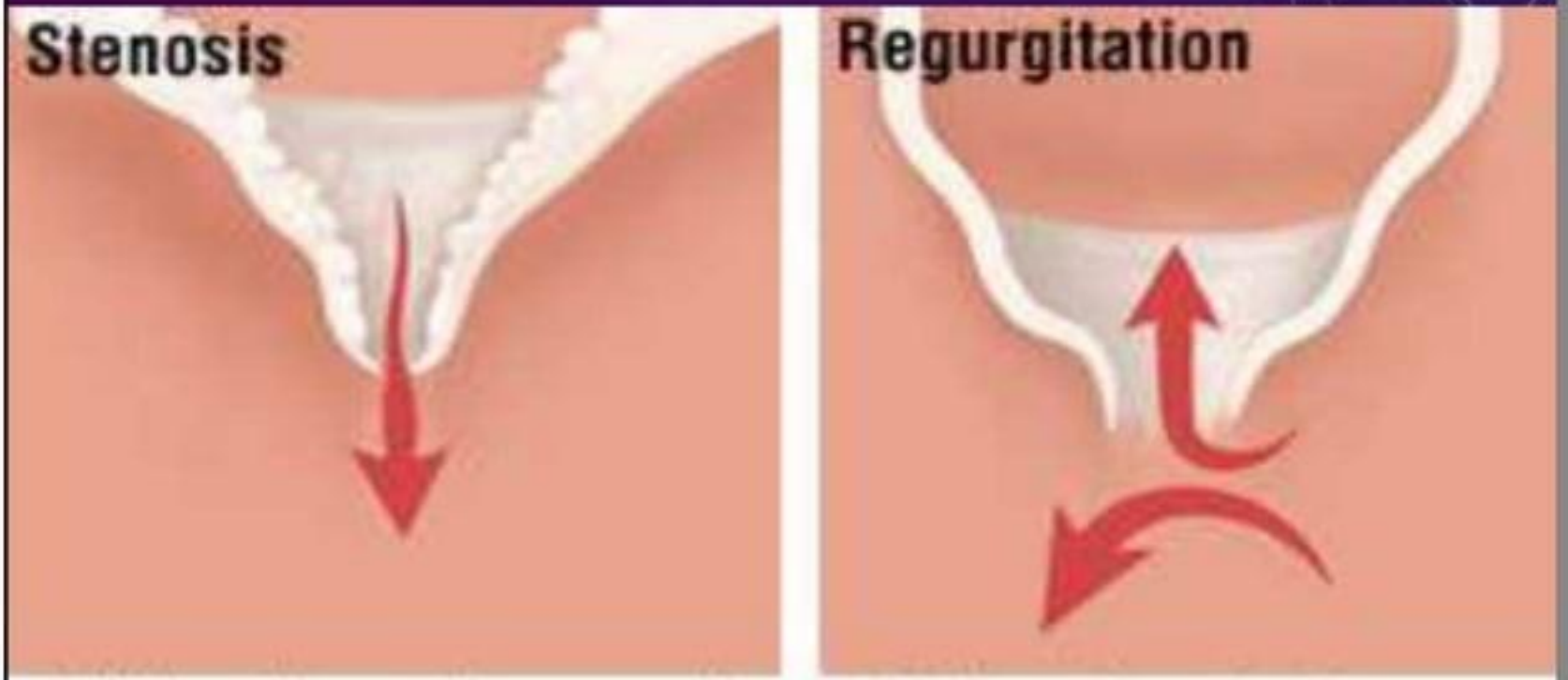
2. Nature of valvular dysfunction

   Stenosis and regurgitation

3. Degree of dysfunction :

   NYHA degree of cardiac dysfunction

TYPES OF VALVE DISEASE



Valve doesn't open all the way, not enough blood passes through

Valve doesn't close all the way so blood leaks backwards

VALVULAR STENOSIS

THE VALVE OPENING NARROWS:

- **The valve leaflets may become fused or thickened that the valve cannot open freely → obstructs the normal flow of blood**

EFFECTS: The chamber behind the stenotic valve is subject to greater stress → must generate more pressure (work hard) to force blood through the narrowed opening

- initially, the ❤ compensates for the additional workload by gradual hypertrophy and dilation of the myocardium

  → **heart failure**

VALVULAR REGURGITATION

LEAKAGE OR BACKFLOW OF BLOOD RESULTS FROM INCOMPLETE CLOSURE OF THE VALVE

- Due to: **scarring and retraction of valve leaflets**

Or

- **Weakening of supporting structures**

Effects:

Causes the heart to pump the same blood twice (as the blood comes back into the chamber)

- The heart dilates to accommodate more blood
- Ventricular dilation and hypertrophy → eventually leads to **heart failure**

Essential questions in the evaluation of patients for valvular intervention

Questions
• How severe is VHD?
• What is the aetiology of VHD?
• Does the patient have symptoms?
• Are symptoms related to valvular disease?
• Are any signs present in asymptomatic patients that indicate a worse outcome if the intervention is delayed?
• What are the patient's life expectancy[a] and expected quality of life?
• Do the expected benefits of intervention (versus spontaneous outcome) outweigh its risks?
• What is the optimal treatment modality? Surgical valve replacement (mechanical or biological), surgical valve repair, or catheter intervention?
• Are local resources (local experience and outcome data for a given intervention) optimal for the planned intervention?
• What are the patient's wishes?

Diagnosis

- History
- Physical examination
- ECG
- Chest x-ray
- Echocardiography
- Invasive evaluation, CT, MRI

History

- Other known heart diseses
- Congenital heart disease, **bicuspid aortic valve**
- Ischemic heart disease
- Rheumatic fever
- Hypertrophic/dilated cardiomyopathy
- Aortic diseases – Marfans,Ehlers-Danlos

History

- Generally: symptoms of heart failure and low cardiac output
- Breathlessness
- Chest pain or dyscomfort
- Syncope
- Fatigue
- Peripheral or pulmonary oedema
- Palpitations

Physical examination

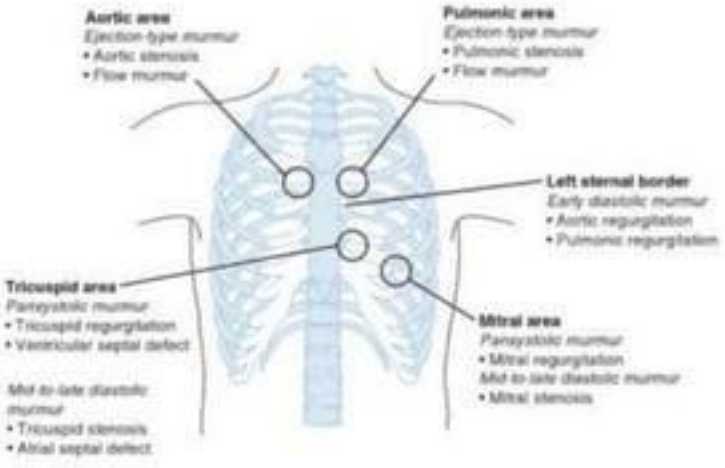
- MURMURS!!!
- Periferal oedema
- Lung crackles
- Elevated JVP
- Displaced apex beat, irregular heart beat…

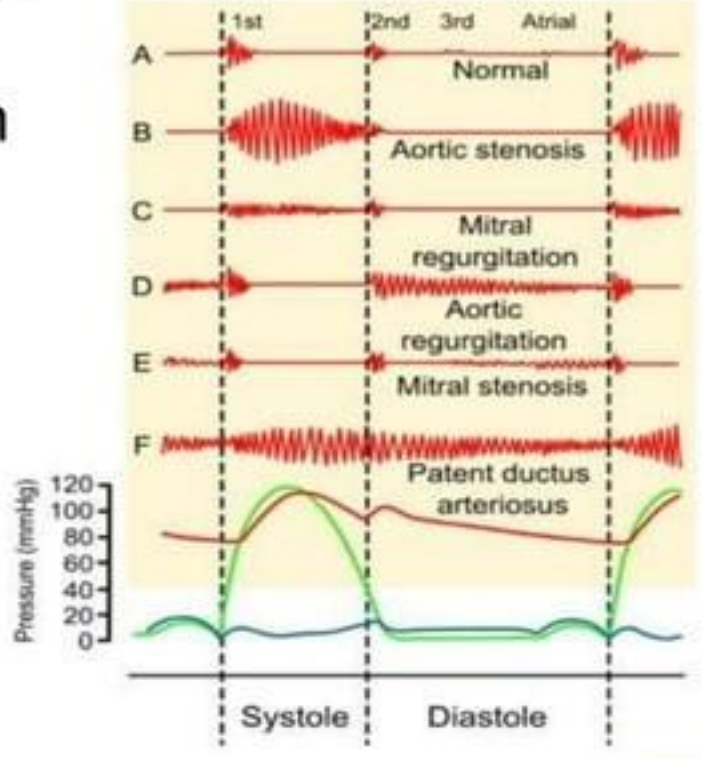
Hundreds of eponymous signs from past millenium (↓importance in daily routine, ↑importance for passing exam

Light House
Malar flushing with heartbeat
Quincke's
Pulsatile blanching & reddening of nail when slight pressure is applied
HILL's
Systolic BP in Lower Limb greater than upper limb by 20mm Hg
Alfred De Musset's
Nodding of head with heartbeat
Corrigon's pulse
Large Carotid pulse
Durozier's
Diastolic murmur over femoral artery on Distal pressure

Heart murmurs

- Sounds produces by turbulent blood flow (in valve diseseses, artery stenosis, abnormal chamber or AVcommunication
- Localization,grade, propagation, timing, quality





Phonocardiograms from normal and abnormal heart sounds

Heart murmurs

Intensity	Description
Grade I/VI	Barely audible
Grade II/VI	Audible, but soft
Grade III/VI	Easily audible
Grade IV/VI	Easily audible, associated with a thrill
Grade V/VI	Easily audible, associated with a thrill, and still audible with the stethoscope onlylightly on the chest
Grade VI/VI	Easily audible, associated with a thrill, and still audible with the stethoscope off of the chest

ECG

- Not specific
- Findings might be caused or altered by other concomitant heart disease (hypertensive heart disease, ischemic heart disease)

- Left ventricular hypertrophy (aortic valve disease)
- Left atrial enlargement (mainy MS, but any left heart valve disease)
- Atrial fibrilation
- Bundle branch block
- Arrytmias (atrial fibrilation, ectopic beats)

Chest x-ray in valvular disease

- Different heart shapes in different valvular heart diseses, ↓specificity, ↓significance

- Cardiomegaly, pulmonary congestion
- Widened mediastinum
- Valve calcifications, prosthetic valves

Echocardiography

- **Mainstay of valve disease diagnosis and follow-up**
- Allows real-time measurement of chamber and wall diameters, ejection fraction assessment and functional valve evaluation
- Easily avaiable and repeated
- Essential in acute valve disease diagnosis
- No radiation harm
- Trans-esophageal echocardiography avaiable for patients with poor transthoracic sonographic window

Invasive evaluation, CT, MRI

- Methods usualy used for uncertain cases or repeat cardiac surgery / percutaneous inteventions planning

- Angiography to assess regurgitation severity – direct transcatheter contrast medium administration into heart chambers – aortography, ventriculography
- Hemodynamic measurment – measuring of intracardial pressures and gradients
- CT aortography – method of choice in aortic dissection diagnosis
- CMRI – very precise evaluation of cardiac tissues and function, but expensive, low avaiability, long examination time

Echocardiographic criteria for the definition of severe valve regurgitation: an integrative approach

	Aortic regurgitation	Mitral regurgitation		Tricuspid regurgitation
Qualitative				
Valve morphology	Abnormal/flail/large coaptation defect	Flail leaflet/ruptured papillary muscle/ large coaptation defect		Abnormal/flail/large coaptation defect
Colour flow regurgitant jet	Large in central jets, variable in eccentric jets[a]	Very large central jet or eccentric jet adhering, swirling, and reaching the posterior wall of the LA		Very large central jet or eccentric wall impinging jet[a]
CW signal of regurgitant jet	Dense	Dense/triangular		Dense/triangular with early peaking (peak <2 m/s in massive TR)
Other	Holodiastolic flow reversal in descending aorta (EDV >20 cm/s)	Large flow convergence zone[a]		–
Semiquantitative				
Vena contracta width (mm)	>6	≥7 (>8 for biplane)[b]		≥7[b]
Upstream vein flow[c]	–	Systolic pulmonary vein flow reversal		Systolic hepatic vein flow reversal
Inflow	–	E-wave dominant ≥1.5 m/s[d]		E-wave dominant ≥1 m/s[e]
Other	Pressure half-time <200 ms[f]	TVI mitral/TVI aortic >1.4		PISA radius >9 mm[g]
Quantitative		Primary	Secondary[h]	
EROA (mm^2)	≥30	≥40	≥20	≥40
Regurgitant volume (mL/beat)	≥60	≥60	≥30	≥45
+ enlargement of cardiac chambers/vessels	LV	LV, LA		RV, RA, inferior vena cava

TRICUSPID VALVE DISEASE

TRICUSPID STENOSIS

- Usually occurs together with aortic or mitral stenosis
- May be due to rheumatic heart disease (<5%)
- ↓ Blood flow from right atrium to right ventricle
  - ↳ ↓ right ventricular output
    - ↳ ↓ Left ventricular filling → ↓ co
- ↑ Systemic pressure

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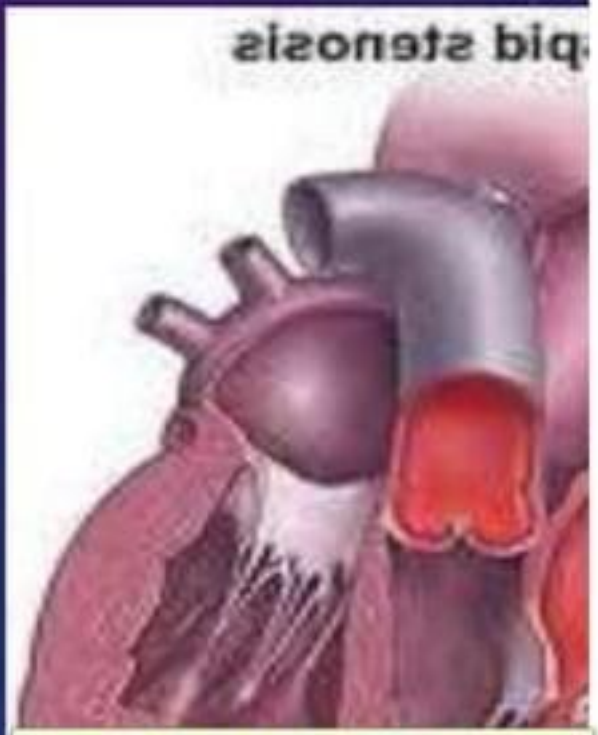
TRICUSPID STENOSIS

Symptoms :

- symptoms of right-sided heart failure
  - Hepatomegaly
  - Ascites
  - Peripheral edema
  - Neck vein engorgement
- ↓ co – fatigue, hypotension



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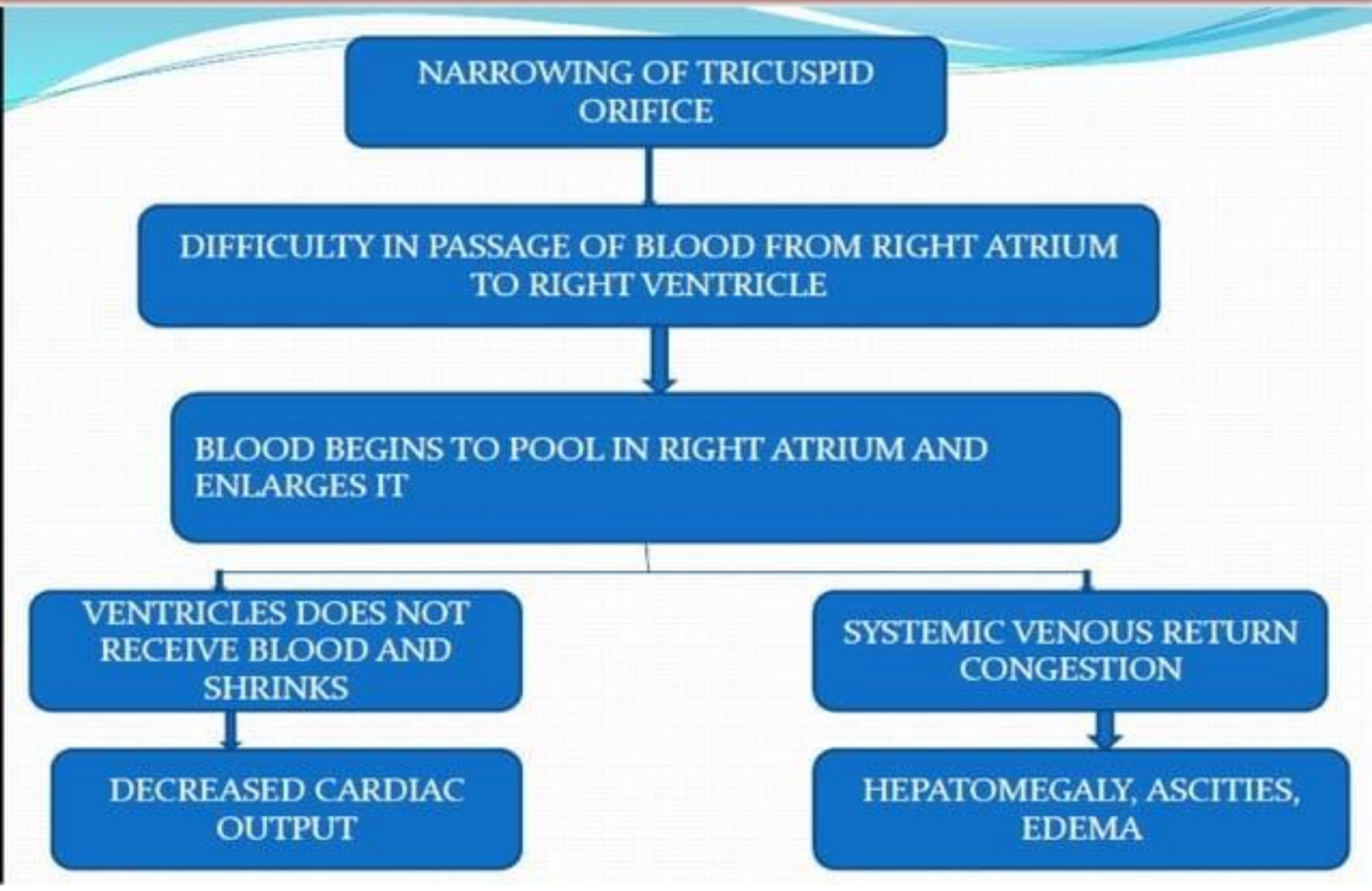
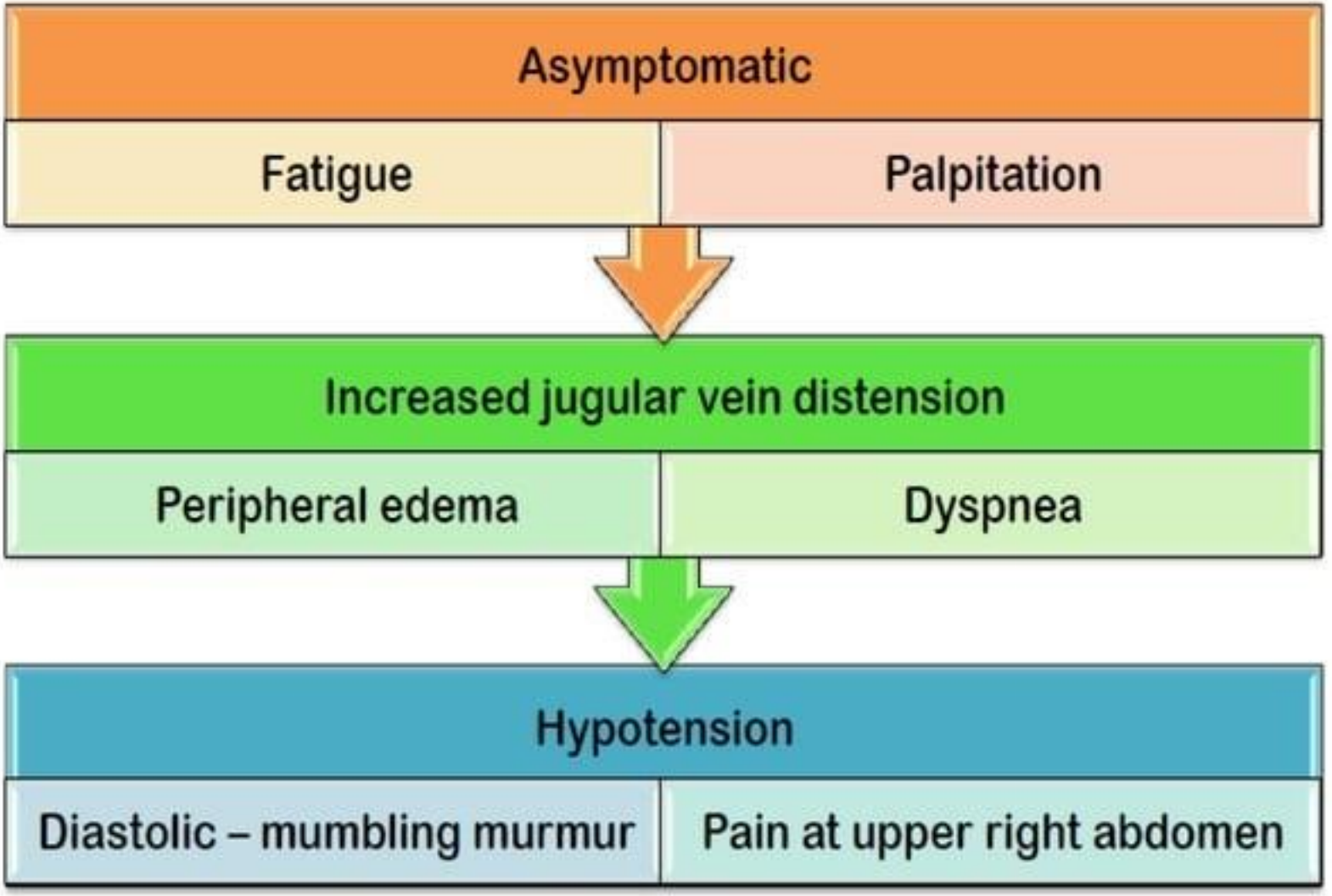
Pathophysiology


NARROWING OF TRICUSPID ORIFICE
DIFFICULTY IN PASSAGE OF BLOOD FROM RIGHT ATRIUM TO RIGHT VENTRICLE
BLOOD BEGINS TO POOL IN RIGHT ATRIUM AND ENLARGES IT
VENTRICLES DOES NOT RECEIVE BLOOD AND SHRINKS
DECREASED CARDIAC OUTPUT
SYSTEMIC VENOUS RETURN CONGESTION
HEPATOMEGALY, ASCITIES, EDEMA

CLINICAL MANIFESTATION



Tricuspid valve disesease

- **Tricuspid regurgitation**
- **Is usually secondary** – due to right ventricle dilation and failure as a result of pumonary hypertension (the most common cause of right heart failure is left heart failure) or volume overload (left-right shunt abnormalities)
  - Cor pulmonale – right ventricle failure in pulmonary disease

- **Primary:**
  - **Infective endocarditis – in i.v. abusers**
  - Other are rare - Carcinoid, rheumatic, **Ebstein anomaly** – apical displacement of septal and posterior leaflet of tricuspid valve → „atrialization" of a portion of the morphologic right ventricle

- **Symptoms of right heart failure** – periferal oedema, elevated JVP, hepatomegaly, ascites...
- Symptoms treated by diuretics, surgical treatment is only indicated in case of left sided valve intervention

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Tricuspid valve disesease

Tricuspid stenosis is a rare condition, whereas tricuspid regurgitation
is more common, especially in its secondary form.

- For appropriate management, secondary tricuspid regurgitation has to be clearly distinguished from primary tricuspid regurgitation.

Similar to mitral regurgitation, primary tricuspid regurgitation requires intervention sufficiently early to avoid secondary damage of the RV, which is associated with poor outcome.

- Secondary tricuspid regurgitation should be liberally treated at the time of left-sided valve surgery.
- Consideration of isolated surgery of secondary tricuspid regurgitation after previous left-sided valve surgery requires comprehensive assessment of the underlying disease, pulmonary haemodynamics and RV function.

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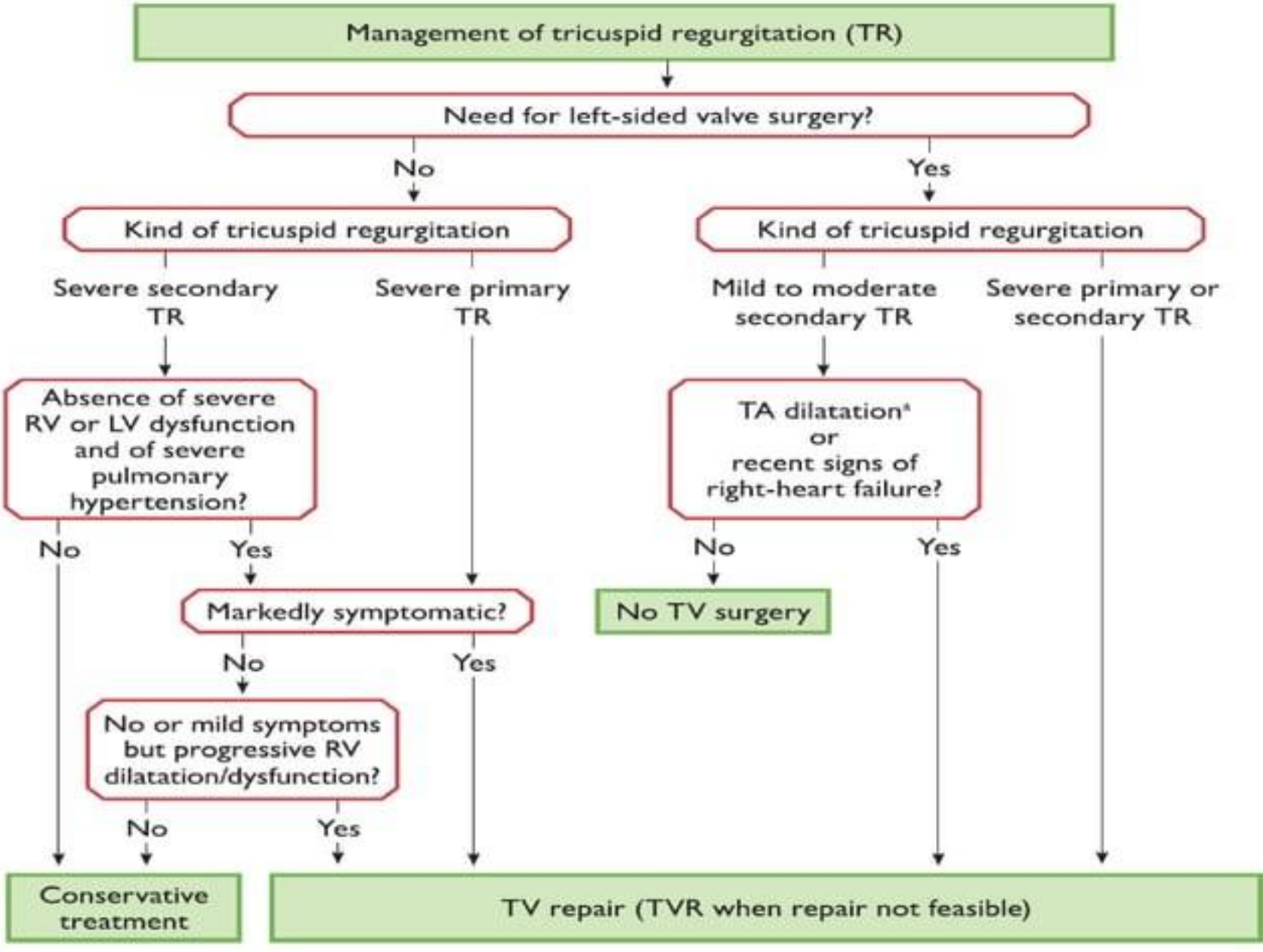
Findings Indicative of Hemodynamically Significant Tricuspid Stenosis

Specific Findings	
Mean pressure gradient	≥ 5 mm Hg
Inflow time velocity integral	> 60 cm
T ½	≥ 190 ms
Valve area by continuity equation*	≤ 1 cm_2
Supportive Findings	
Enlarge right atrium ≥ moderate	
Dilated inferior vena cava	


Management of tricuspid regurgitation (TR)
Need for left-sided valve surgery?
No
Yes
Kind of tricuspid regurgitation
Kind of tricuspid regurgitation
Severe secondary TR
Severe primary TR
Mild to moderate secondary TR
Severe primary or secondary TR
Absence of severe RV or LV dysfunction and of severe pulmonary hypertension?
TA dilatation[a] or recent signs of right-heart failure?
No
Yes
No
Yes
Markedly symptomatic?
No TV surgery
No
Yes
No or mild symptoms but progressive RV dilatation/dysfunction?
No
Yes
Conservative treatment
TV repair (TVR when repair not feasible)

Indications for tricuspid valve surgery

Recommendations	Class[a]	Level[b]
Recommendations on tricuspid stenosis		
Surgery is indicated in symptomatic patients with severe tricuspid stenosis.[c]	I	C
Surgery is indicated in patients with severe tricuspid stenosis undergoing left-sided valve intervention.[d]	I	C
Recommendations on primary tricuspid regurgitation		
Surgery is indicated in patients with severe primary tricuspid regurgitation undergoing left-sided valve surgery.	I	C
Surgery is indicated in symptomatic patients with severe isolated primary tricuspid regurgitation without severe RV dysfunction.	I	C
Surgery should be considered in patients with moderate primary tricuspid regurgitation undergoing left-sided valve surgery.	IIa	C
Surgery should be considered in asymptomatic or mildly symptomatic patients with severe isolated primary tricuspid regurgitation and progressive RV dilatation or deterioration of RV function.	IIa	C

Recommendations on secondary tricuspid regurgitation		
Surgery is indicated in patients with severe secondary tricuspid regurgitation undergoing left-sided valve surgery.	I	C
Surgery should be considered in patients with mild or moderate secondary tricuspid regurgitation with a dilated annulus (≥40 mm or > 21 mm/m^2 by 2D echocardiography) undergoing left-sided valve surgery.	IIa	C
Surgery may be considered in patients undergoing left-sided valve surgery with mild or moderate secondary tricuspid regurgitation even in the absence of annular dilatation when previous recent right-heart failure has been documented.	IIb	C
After previous left-sided surgery and in absence of recurrent left-sided valve dysfunction, surgery should be considered in patients with severe tricuspid regurgitation who are symptomatic or have progressive RV dilatation/dysfunction, in the absence of severe RV or LV dysfunction and severe pulmonary vascular disease/hypertension.	IIa	C

COMPLICATION

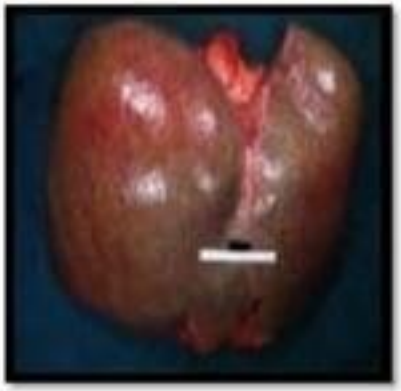
CHRONIC HEART FAILURE

ENDOCARDITIS

LIVER CIRHOSIS

COMPLICATION

HEPATOMEGALY



ASCITES

TYPES OF SURGERY

REPAIR :

1. Surgery of choice
2. Mitral and Tricuspid heart disease
3. Lower mortality
4. Don't establish total valve competence.

REPLACEMENT :

1. Mitral ,Aortic and Tricuspid valvular heart disease.
2. Treatment of choice for combined AS and AR.

TYPES OF PROSTHETIC VALVES

- Two types of prosthetic valves :-
  - Mechanical valves
  - Tissue(biologic) valves

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ADVANTAGES

- More durable
- Can be used if the patient has hypercalcemia, endocarditis or sepsis.
- Do not deteriorate or become infected as easily as the tissue valves.

DISADVANTAGES

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- Life long anticoagulation with warfarin required.
- Increased risk of thrombo embolism.
- Not suitable for women of child bearing age.

DIFFERENCES BETWEEN MECHANICAL AND BIOPROSTHETIC VALVE

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	MECHANICAL	BIOPROSTHETIC
LIFESPAN	30 YEARS OR MORE	10-15 YEARS
THROMBOGENICITY	MORE	LESS
NOISE	MORE	NEGLIGIBLE
PATIENT-PROSTHESIS MISMATCH	MORE	LESS
VALVE DETERIORATION	DURABLE	HIGHLY SUSCEPTIBLE
HEMODYNAMICS	IMPROVING	CLOSE TO NATURAL
ANTICOAGULATION	LIFELONG	3 MONTHS
RISK OF REOPERATION	LESS	MORE

Choice of the aortic/mitral prosthesis in favour of a mechanical prosthesis; the decision is based on the integration of several of the following factors

Recommendations	Class[a]	Level[b]
A mechanical prosthesis is recommended according to the desire of the informed patient and if there are no contraindications to long-term anticoagulation.[c]	I	C
A mechanical prosthesis is recommended in patients at risk of accelerated structural valve deterioration.[d]	I	C
A mechanical prosthesis should be considered in patients already on anticoagulation because of a mechanical prosthesis in another valve position.	IIa	C
A mechanical prosthesis should be considered in patients <60 years of age for prostheses in the aortic position and <65 years of age for prostheses in the mitral position.[e]	IIa	C
A mechanical prosthesis should be considered in patients with a reasonable life expectancy[f] for whom future redo valve surgery would be at high risk.	IIa	C
A mechanical prosthesis may be considered in patients already on long-term anticoagulation due to the high risk for thromboembolism.[g]	IIb	C

Target INR for mechanical prostheses

Prosthesis thrombogenicity	Patient-related risk factors[a]	
	None	≥1 risk factor
Low[b]	2.5	3.0
Medium[c]	3.0	3.5
High[d]	3.5	4.0

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Recommended requirements of a heart valve Centre

Requirements
Multidisciplinary teams with competencies in valve replacement, aortic root surgery, mitral, tricuspid and aortic valve repair, as well as transcatheter aortic and mitral valve techniques including reoperations and reinterventions. The Heart Teams must meet on a regular basis and work with standard operating procedures.
Imaging, including 3D and stress echocardiographic techniques, perioperative TOE, cardiac CT, MRI, and positron emission tomography-CT.
Regular consultation with community, other hospitals, and extracardiac departments, and between non-invasive cardiologists and surgeons and interventional cardiologists.
Back-up services including other cardiologists, cardiac surgeons, intensive care and other medical specialties.
Data review: • Robust internal audit processes including mortality and complications, repair rates, durability of repair, and reoperation rate with a minimum of 1-year follow-up. • Results available for review internally and externally. • Participation in national or European quality databases.